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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/975,324	10/10/2001	Giuseppe Rossi	08305-115001 / 20-29	6931

7590 06/19/2003

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EXAMINER	
YAM, STEPHEN K	
ART UNIT	PAPER NUMBER
2878	

DATE MAILED: 06/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application N .	Applicant(s)
	09/975,324	ROSSI, GIUSEPPE
	Examiner	Art Unit
	Stephen Yam	2878

-- *The MAILING DATE of this communication appears n the c ver sheet with the correspondenc address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 March 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

This action is in response to Amendments and remarks filed on March 11, 2003. Claims 1-26 are currently pending.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-15 and 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over North US Patent No. 6,081,558.

Regarding Claims 1-4 and 7, North teaches (see Fig. 2) a method of changing the gain of an amplifier (54, 56) in the gain stage of a sensor in response to a signal read out from a pixel sensor (24) and changing (I_1, I_2) (see Fig. 3) the power consumption of the amplifier in the gain stage in response to changing the gain. Regarding Claim 2, North teaches (see Fig. 3) changing the power consumption by changing a transconductance of an input transistor (within I_1 and I_2) (see Col. 5, lines 64-66: inherently, current mirrors contain a current source and a plurality of transistors to control current flow) in the amplifier. Regarding Claim 3, North teaches decreasing the power consumption in response to a decrease in the gain and increasing the power consumption in response to an increase in the gain (see Col. 7, lines 9-13). Regarding Claims 4 and 7, North teaches associating a plurality of power consumption settings with a plurality of gain settings, selecting a gain setting from the plurality of gain settings, and selecting a power

consumption setting associated with the gain setting (see Col. 5, line 66 to Col. 6, line 4), where each gain is associated with a power consumption setting. North does not teach the sensor element as a pixel array. It is well known in the art to use a pixel array to capture two-dimensional data for imaging and optical communications. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a pixel array in the method of North, to provide multi-optical channels for higher data bandwidth.

Regarding Claims 5 and 6, North teaches the method as taught in Claim 4, according to the appropriate paragraph above. North does not teach eight gain settings or three power consumption settings. It is design choice how many gain settings and power consumption settings are used, to provide a more-precise, more-expensive control setup or a less-optimal, less-expensive setup. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use eight gain settings and three power consumption settings in the method of North, to provide sufficient settings to save power and provide variable gain levels while not dramatically increasing the complexity of the sensor.

Regarding Claims 8-10, North teaches (see Fig. 2) selecting (56) one of a plurality of gain settings in response to a signal read out from a pixel sensor (24), generating (see Fig. 3) two or more bias currents (into current mirrors I_1 and I_2) according to the current gain setting (I_{AGC}) (see Col. 7, lines 9-13), and applying said two or more bias currents to a plurality of parallel transistors (within I_1 and I_2) (see Col. 5, lines 64-66: inherently, current mirrors contain a current source and a plurality of transistors to control current flow) in a gain stage of the sensor in order to change the input transconductance of the amplifier. Regarding Claims 9 and 10, North teaches each gain setting having an associated input transconductance setting (a specific gain

will output a constant I_{AGC}) (see Col. 6, lines 55-57), and the input transconductance setting associated with a bias current value (of I_{AGC}). North does not teach the sensor element as a pixel array. It is well known in the art to use a pixel array to capture two-dimensional data for imaging and optical communications. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a pixel array in the method of North, to provide multi-optical channels for higher data bandwidth.

Regarding Claims 11-15, North teaches (see Fig. 2) an apparatus comprising a gain stage (54, 56) for a sensor with a differential amplifier (54), including a gain selector (56) operative to select a gain setting in response to a signal from a photodiode, an input transistor (within I_1 and I_2) (see Col. 5, lines 64-66: inherently, current mirrors contain a plurality of transistors to control current flow) having a variable input transconductance, and a transconductance controller (within (56) outputting I_{AGC}) operative to select an input transconductance of the input transistor in response to a selected gain setting. Regarding Claim 12, North teaches the transconductance operative to select an input transconductance setting associated with the selected gain setting from a plurality of input transconductance settings (see Col. 5, lines 58-60, Col. 6, lines 55-58, and Col. 7, lines 9-13). Regarding Claim 13, North teaches (see Fig. 3) the input transistor comprising a first plurality of parallel transistors connected to a first bias current supply (within I_1) (inherently, current mirrors contain a current source and a plurality of transistors to control current flow) and a second plurality of parallel transistors connected to a second bias current supply (within I_2). Regarding Claim 14, North teaches (see Fig. 2) the transconductance controller comprising a bias current selector (to determine I_{AGC}) (see Col. 6, lines 1-4) selecting values for a first bias current and a second bias current associated with a selected gain setting

(determined from gain control circuit (56)), and a bias current generator (to generate I_{AGC} within the controller) to generate the selected values for first and second bias current and apply it to the first and second bias current supply (see Fig. 3). Regarding Claim 15, inherently changing the current value of I_{AGC} provides a different current flow for I_1 and I_2, therefore providing a different input transconductance by providing a bias current. North does not teach the sensor element as a pixel array. It is well known in the art to use a pixel array to capture two-dimensional data for imaging and optical communications. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a pixel array in the apparatus of North, to provide multi-optical channels for higher data bandwidth.

Regarding Claims 18-21, North teaches (see Fig. 2) a sensor comprising a pixel (24), a read-out section (part of (24) operative to read out signals (D_{IR}) generated by the pixel, a gain stage having an amplifier including a gain selector (56) to set the gain of the amplifier in response to the pixel signal, an input transistor (within I_1 and I_2) (see Col. 5, lines 64-66: inherently, current mirrors contain a current source and a plurality of transistors driven by a voltage signal to control current flow) having an input transconductance and including a first and second plurality of parallel transistors connected to a first bias current supply (within I_1) and a second bias current supply (within I_2), respectively, and a transconductance controller (within gain control circuit (56)) to change the transconductance of the input transistor to match a selected gain setting (see Col. 7, lines 9-13) by applying different bias currents (changing I_{AGC}) to at least one of the first and second current supplies for different gain settings (see Col. 5, lines 58-60 and Col. 6, lines 55-57). Regarding Claim 19, North teaches a gain decoder (within gain control circuit (56)) to select a bias current value (I_{AGC}) in response to the gain, and a bias

generator (generating I_{AGC}) to generate and apply the bias current value to the first and second bias current supplies. Regarding Claim 20, North teaches increasing and decreasing the input transistor transconductance for a gain increase and decrease, respectively (see Col. 5, lines 58-60 and Col. 6, lines 55-57). North does not teach the sensor element as a pixel array or active pixel sensor, or the amplifier as a differential amplifier. It is well known in the art to use a pixel array to capture two-dimensional data for imaging, to use active pixels to provide a greater-intensity detection signal, and to use a differential amplifier to provide a different zero level for the input. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use an active pixel array and a differential amplifier in the sensor of North, to capture more-accurate, multi-dimensional data for imaging purposes and provide a separate reference level in which to amplify the signal to provide an adjustable detection contrast.

3. Claims 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over North in view of Kozlowski et al. US Patent No. 5,892,540.

Regarding Claims 16 and 17, North teaches the apparatus as taught in Claim 14, according to the appropriate paragraph above. Regarding Claim 17, North teaches the bias current selector operative to select a set of current values (from a minimum to a maximum I_{AGC}) in response to the desired I_{AGC} from a gain decoder. North does not teach the gain selector including a plurality of switches and operative to select a different set of switches for each of the plurality of gain settings. Kozlowski et al. teach (see Fig. 1) an amplifier device for a photodetector pixel array (12) (see Col. 5, lines 18-24) with a plurality of switches (in (22) adjacent/serial to 30A, 30B, 30C, 30D) for each of the plurality of gain settings. It would have

been obvious to one of ordinary skill in the art at the time the invention was made to use the switches of Kozlowski et al. in the apparatus of North, to provide a simple, cost-effective method of dynamically modifying the gain for a feedback amplifier.

4. Claims 22-26 are rejected under 35 U.S.C. 103(a) as being unpatentable by Williams US Patent No. 5,864,416.

Regarding Claim 22, Williams teaches (see Fig. 1) a method of changing (through changing the value of variable feedback capacitor (79)) the gain of an amplifier (20, 40) in response to a signal read out from an imaging pixel (10), and changing (40) a gain bandwidth product (GBW) of the amplifier in the gain stage in response to changing the gain (see Col. 1, line 60 to Col. 2, line 5), as changing one of the two amplifier characteristics (gain or operating bandwidth) has no effect on the other characteristic (see Col. 3, lines 28-32). Regarding Claim 23, Williams teaches changing the GBW comprising changing a transconductance of an input transistor (47) in the amplifier (see Col. 2, line 65 to Col. 3, line 4). Regarding Claim 24, since changing each amplifier characteristic has no bearing on the other amplifier characteristic (see Col. 3, lines 28-32), a decrease/increase in the gain with a constant operating bandwidth leads to a decrease/increase in the GBW. Williams does not teach the sensor element as a pixel array. Regarding Claims 25 and 26, RMS noise inherently occupies all frequencies, so therefore decreasing the operating bandwidth decreases the amount of RMS noise (from cutting off the noise in the deleted frequency bandwidth range) (see also Col. 2, lines 5-8) and decreasing the gain also decreases the amplification amount of RMS noise, hence decreasing the overall RMS noise level, and for the same reasons, increasing the GBW increases the RMS noise. Williams

does not teach the sensor element as a pixel array. It is well known in the art to use a pixel array to capture two-dimensional data for imaging and optical communications, and to recalibrate the required gain bandwidth after changing a gain, to optimize amplification frequencies. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a pixel array and respond to a gain change in the method of Williams, to provide multi-optical channels for higher data bandwidth.

Response to Arguments

5. Applicant's arguments filed March 11, 2003 have been fully considered but they are not persuasive.

Regarding Applicant's arguments for Claims 1-7 on the North reference, Applicant argues that North does not teach or suggest a gain adjusted system responsive to pixel output signals or changing power consumption in response to a change in gain. Examiner asserts that North does teach changing the power consumption in response to a change in the gain, as discussed in Col. 7, lines 9-23. Further, Applicant argues that North does not teach or suggest a gain adjusted system responsive to pixel output signals. Examiner asserts that North does teach adjusting the gain in response to the output signal of the photodetection/pixel, as the gain is controlled by AGC control unit (56) which receives an input from the output of amplifier (54) which amplifies the pixel output signal- hence, the pixel output signal affects the gain of the amplifier. In addition, Examiner maintains that applying the particulars of a single detector element for a detector/pixel array is well known in the art, and that the sensor of North can also be interpreted as having a single-element 1x1 pixel array. In addition, Examiner submits that the

power consumption of an amplifier is directly proportional to the bias current fed into the amplifier- therefore, changing the bias current for the amplifier changes both the gain and the power consumption of the amplifier.

Regarding Applicant's arguments for Claims 8-10 on the North reference, Applicant argues that North does not teach or suggest a gain adjusted system responsive to pixel output signals or a change in the bias current in response to the change in gain. Examiner asserts that North does teach changing the bias current in response to the change in the gain, as discussed in Col. 5, lines 5, lines 58-60, Col. 6, lines 55-57, and Col. 7, lines 9-23. Further, Applicant argues that North does not teach or suggest a gain adjusted system responsive to pixel output signals. Examiner asserts that North does teach adjusting the gain in response to the output signal of the photodetection/pixel, as the gain is controlled by AGC control unit (56) which receives an input from the output of amplifier (54) which amplifies the pixel output signal- hence, the pixel output signal affects the gain of the amplifier. In addition, Examiner maintains that applying the particulars of a single detector element for a detector/pixel array is well known in the art, and that the sensor of North can also be interpreted as having a single-element 1x1 pixel array.

Regarding Applicant's arguments for Claims 11-21 on the North reference, Applicant argues that North does not teach or suggest a gain adjusted system responsive to pixel output signals or a change in input transconductance in response to the change in gain. Examiner asserts that by changing the gain by changing the bias current, the input transconductance within a transimpedance amplifier is inherently changed and that a transimpedance amplifier inherently contains an input transistor. Examiner further cites Alini et al. US Patent No. 5,495,201, Col. 3, lines 2-4 for support that varying the bias current varies the transconductance in an amplifier. In

addition, Examiner maintains that applying the particulars of a single detector element for a detector/pixel array is well known in the art, and that the sensor of North can also be interpreted as having a single-element 1x1 pixel array.

Regarding Applicant's arguments for Claims 22-26, it appears that Applicant misinterpreted the initial rejection, as Claims 22-26 are rejected under 35 USC 103(a) by Williams US Patent No. 5,864,416, and not North in view of Williams. Thus, Applicant's arguments are moot, since Williams does indeed teach changing a gain bandwidth of the amplifier in response to changing the gain (through changing the value of variable feedback capacitor (79)), in Col. 1, line 60 to Col. 2, line 5.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephen Yam whose telephone number is (703)306-3441. The examiner can normally be reached on Monday-Friday 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Porta can be reached on (703)308-4852. The fax phone numbers for the organization where this application or proceeding is assigned are (703)308-7724 for regular communications and (703)308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

SY
June 4, 2003

DAVID PORTA
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